

ART. X.—*Glacial Deposits at Taminick, Glenrowan and Greta, North-Eastern District, Victoria.*

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The occurrence of glacial deposits in the North-Eastern District of Victoria has been known for many years. They have been recorded by Mr. Norman Taylor¹ from Rutherglen and Springhurst, and Mr. E. J. Dunn has observed them at Eldorado and Tarrawingee.

Later on Mr. W. H. Ferguson mapped a number of disconnected occurrences in the Greta and Hansen districts, and two near Pelluebla in the Tungamah district. There are also indicated on the new geological map of Victoria two areas at Wooragee.

These occurrences are principally in the basins of the Doma Mungi or Black Dog Creek, and of the King and Ovens Rivers, between Futter's and Tatong Ranges on the west, and the Pilot and Black Ranges on the east.

In the Taminick and Glenrowan districts no previous record of glacial deposits has been made, while those in the Greta district, though already mapped, have not yet been described. A few remarks will therefore be made upon them before dealing with the Taminick and Glenrowan occurrences.

GRETA DEPOSITS.

In the parishes of Greta and Laceby, between the King River and the Fifteen Mile Creek, there are no fewer than 14 inliers of glacial deposits varying in area from about 10 acres to 3 square miles. They occur in the broad plain west of the King River. The most northerly occurrence, on the boundary between the two parishes, may be taken as a typical example, and described in a

¹ Geological Report on the North-Eastern District. Prog. Rep. Geol. Surv. Vic., No. viii., p. 37.

general way. It covers an area of about 800 acres, forming a hill rising to the height of about 120 feet above the general level of the surrounding flats, and about 680 feet above sea level. This hill will be referred to as Mundara, since Mr. A. H. Smith's residence, "Mundara," is picturesquely situated on its northern slope.

The principal material visible on the hill is a yellow and reddish-yellow finely sandy and gravelly clay with pebbles and boulders. The colour of this material may be due to decomposition, but as no natural or suitable artificial section was visible the colour of the underlying material could not be ascertained. What can be seen, however, has the appearance of till. On the north-western side of the hill, among the debris thrown out of an old well—now filled up—are pieces of finely sandy and micaceous shale or fissile mudstone, with small patches of comminuted carbonaceous matter, like fragments of plants. This material is fairly calcareous, and of olive-green colour. Whether it occurs as a stratum, or only as a large boulder, cannot be determined on the visible evidence.

Scattered rather plentifully over the surface of the hill are numerous small and large pebbles, and a few boulders of grey and brown quartzites, lydianite, plain, banded and brecciated cherts of various colours from white to black, quartz, agates, indurated and normal sandstones and mudstones, fine and medium conglomerates, quartz and felspar felsites, and grey and red granites; while blocks of granite can be seen embedded in the material at the surface. Many of these sandstone pebbles and blocks contain casts of brachiopods of the Silurian period, similar to those stated¹ by Mr. Norman Taylor as occurring in the glacial deposits at Springhurst. Fine examples of these are in the possession of Mr. A. H. Smith.

Many of the pebbles are polished, widely grooved, and bear numerous striae. Some of them have one side smoothed and rounded, while the other side is sharply broken, or split off longitudinally, as if along a joint plane. The striated pebbles are chiefly of yellow, grey, and brown quartzites, and siliceous mudstones.

¹ *Op. cit.*

On the top of the hill there occur several blocks and pieces of red granite much resembling that of Futter's and the Mokoan Ranges. The striated pebbles are fairly numerous, and on some of them the striae are not sharp and clear, but much worn on the edges, as if indicating long-continued weathering. Extended and careful collecting would probably result in examples of other rocks and fossils than those named being obtained.

GLENROWAN AND TAMINICK DEPOSITS.

These deposits occur in the valley lying between Futter's Range on the east and the Mokoan Ranges on the west, from 3 to 4 miles north-west of Glenrowan, a station on the Melbourne to Sydney railway, 136 miles from the former city, and 747 feet above sea level.

They prove the westward extension of these North-Eastern glacial deposits. No similar deposits have, as far as ascertainable, been recorded within a distance of at least 40 miles to the west of Futter's Range.

There are here three inliers of the material. The largest one occurs in allotments 44^A, 44^B, 45^A, 45^B, 45^D, 61, 61^A, 62, 62^A, 65, parish of Glenrowan, and forms a hill known as Canning's Hill.

CANNING'S HILL.

This hill is essentially composed of claystones, sandstones and slates belonging probably to the Ordovician system. Overlying them are the glacial deposits, about 50 feet thick, which probably belong to the Permo-Carboniferous (Carboniferous) system.

A thin cap of basaltic soil and basalt, about 25 feet thick, possibly of the Eocene period, covers portion of the glacial area. The whole occurrence comprises an area of about 250 acres.

The greater part of the glacial deposit consists of clayey gravels with loose pebbles of agates, quartzites, cherts, indurated sandstones and mudstones, granites, felsites, schists, quartz, etc. In fact, with the exception of fossiliferous sandstone and calcareous mudstone, which were not observed, the rocks of the pebbles here are similar to those at Mundara. Though most of the material as seen is loose, there are parts of the hill where large blocks of highly indurated ferruginous grits and breccia-conglom-

erate are visible. These consist of rocks similar to those of the loose pebbles, and seem to have been formed by the binding together of the underlying deposits by the action of perlocating water from the once overlying cap of basalt. The breccia-conglomerate and grits are, therefore, younger than the glacial deposits. Fragments and small blocks of them occur among the pebbles on other portions of the hill.

Along the flank of the hill on its north-western side there is a reddish-yellow clayey soil, greatly resembling that constituting the main mass of the deposits at Mundara. Lumps of granite similar to that of Futter's, and the Mokoan Ranges occur loose on the surface among the large blocks of ferruginous breccia-conglomerate.

With reference to glacial pebbles, it may be mentioned that in only a few cases have undoubted striae been observed. The general shape of the pebbles, however, combined with the great general resemblance between these deposits and those at Mundara, and the occurrence of the few finely striated pebbles appear to be sufficient evidence to prove their glacial origin.

The nature of the underlying Ordovician? strata has been ascertained by shafts sunk through the basalt near the top of the hill. Two of these shafts bottomed on the Palaeozoic sandstones and slates at 40 feet, after passing through from 20 to 25 feet of soil and decomposed basalt, and from 9 to 20 feet of glacial material; the other bottomed on similar sandstone at 22 feet, after passing through 12 feet of soil and decomposed basalt, and 10 feet of glacial material.

In the glacial material a little fine and coarse gold was found, but not in payable quantity.

Canning's Hill rises to the height of about 60 feet from the flats to the south, or about 650 feet above sea level.

The basalt on the hill is of exceedingly fine texture, and dark blue colour, weathering with grey and brown surfaces into a chocolate soil. Numerous rounded pieces litter the surface of the hill on its highest position, and the general appearance of the rock is similar to that of the "Older Basalts" of Victoria. The occurrence of this small outlier here is of interest, since no other basalt occurs in the district. The nearest known occurrence is that on the divide between the Boggy and Fifteen Mile Creeks,

a distance of 14 miles in a direct line to the south south east. The altitude of this basalt is somewhere about 2000 feet.

The question of whether or not it is a collection of basaltic material brought down by the same agency as transported the pebbles, or is the remnant of an old volcanic flow filling an old valley is one that deserves consideration. A microscopical examination is necessary to determine whether it is a true "older basalt," or a representative of the melaphyres, similar to those of the Upper Devonian series, which so closely resemble the "older basalts" in general appearance. If the latter, by no means an improbability, it will be of assistance as pointing towards a southern origin for the glacial deposits, since the nearest known representatives of Upper Devonian strata occur at Toombullup, about 16 miles to the south.

The other two occurrences of glacial deposits occupy small areas in the parish of Taminick, about one mile to the north-north-west of Canning's Hill. They both form low hills, or rather hillocks, rising to the height of about 25 feet above the flats.

SADLER'S HILL.

The more easterly one comprises an area of about 30 acres in allotments 32^A and 33^A, and will be referred to as Sadler's Hill, since the greater part of it is on the property of Mr. J. R. C. Sadler. The material here is more distinctly of a gravelly and pebbly character than that on Canning's Hill, and no reddish-yellow soil was observed. No pebbles showing distinct striae were found, still, as a prolonged search was not made, it is quite probable they do occur here. The deposit is otherwise similar to that on Canning's Hill.

Cox's HILL.

The other deposit occurs in allotments 18 and 19, owned by Mr. Geo. Cox, and lies half a mile to the west of Sadler's Hill. It has an area of about 35 acres, and will be referred to as Cox's Hill.

Reddish-yellow soil, similar to that at Canning's Hill and Mundara, occurs here. Large and small pebbles are numerous on parts, and though none shows undoubted striae, several of

those found are polished, widely grooved, and have the general appearance of glacial stones. They also show the longitudinal splitting and transverse fracturing so noticeable among the pebbles at Mundara. It is, therefore, by analogy almost wholly that these two occurrences are regarded as of glacial origin. There is, however, to my mind, no doubt about the matter.

It is very probable that they, or at least the visible portions of them, are redistributed glacial material.

All these occurrences lie among the late Cainozoic or younger loam and clay of the wide valley between Futter's Range on the east, and the Winton and Mokoan Ranges on the west and north-west. Futter's Range consists of a grey and red granite of fine and medium texture, as well as of aplite, while the Mokoan Ranges are composed of similar granites and aplite, and early Palaeozoic strata, probably Ordovician or even pre-Ordovician. The granite is distinctly intrusive, and can be seen to ramify the sediments in many places along the southern and eastern flanks of the latter. The Winton Ranges consist of altered sediments similar to those of the Mokoan Ranges.

Along the valley to the north of Sadler's Hill, and distant from it some 70 chains, there is another inlier of Ordovician? strata, forming a hill rising to about 50 feet above the flats. No glacial deposits similar to those on Sadler's, Cox's and Canning's Hills are observable on it. The same may be said with regard to several similar inliers in the same valley, but to the west and south-west of those mentioned. The reason of this is not apparent, assuming the glacial deposits to have originally been portion of one mass, and the question as to whether they are due to a glacier or to floating ice is one that can hardly be settled on the present available evidence.